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Specialisation within Vascular Surgery☆

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Abstract Despite its short existence, vascular surgery has already grown out of the scope of a mono-specialty. Meanwhile emerging interests of other competing specialties push into the field of vascular care. Continuous technological innovation drives the need for sub-specialisation to provide disease-centred expertise; however, treatment success equally depends on balanced patient-centred care. Vascular surgeons are amidst this controversy and are currently challenged by their own demand to offer all aspects of vascular care – as ''the vascular specialist''. This article discusses the natural driving forces towards sub-specialisation and appraises advantages and limitations with respect to the future of integrated vascular care.

As most technology-driven professional fields, surgery has seen a relentless tendency towards specialisation during the second half of the past century. As a result, more than 70% of general surgery residents in the US push currently into specialist training after completion of their general surgery training.[1] From the beginning, vascular surgery has been one of the surgical fields that separated more distinctly from general surgery than others and is recognised already as an independent specialty in many countries. In most others, it has reached at least sub-specialty status.[2,3] Thus, the specialist vascular surgeon is a generally accepted reality.

However, as management of vascular patients is being revolutionised by an exponential growth of endovascular treatment options and the increasing importance of secondary preventive measures, vascular surgeons are challenged by the uncertainty of whether they are still sufficiently specialised or whether they need to sub-specialise to provide optimal care. In brief, there is considerable controversy about an emerging need for specialisation 'within' vascular surgery. The debate seems rampant and its implications extensive as it impacts directly on the self-conception of the vascular surgeon and, with it, the 'natural scope' of vascular surgery, the flow of patients and, last but not least, the scope of future vascular surgery training. This article aims to discuss the natural driving forces, the advantages and the limitations of a 'specialisation within vascular surgery' and attempts to appraise its implications on future integrated vascular care.

Driving Forces Behind Specialisation

Surgical specialisation is driven by a series of interacting intrinsic and extrinsic factors (Table 1). A rapidly expanding

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Table 1 Main drivers of specialisation.

- Expansion of knowledge
- Expertise
- Time restrictions
- Reputation
- Reimbursement
- Independency

understanding of disease biology, the conceptual shift towards miniaturisation of surgical trauma, the concomitant technological (r)evolution, the growing complexity of evidence-based treatment algorithms and the increasing fear of litigation all contribute to the belief that 'expertise requires limitation of scope'. Whatever the driving force, in-depth knowledge, evidence-based treatment and technical mastery of demanding procedures are associated with improved patient outcomes.[4]

By nature, specialisation goes hand in hand with centralisation of services. This leads to a number of advantages in a positive cycle (Fig. 1).[5] Larger units are more likely to afford expensive high-tech infrastructure while realising economic savings through rationalisation. Having the full spectrum of management available will encourage clinically appropriate management more readily than an environment with limited resources and know-how. Further, centralisation means larger patient volumes per unit with improved training opportunities. This facilitates the establishment of sub-specialist interests which, in turn, are associated with improved outcomes[6–8] and reduced chances of success for malpractice allegations. In addition, clinically meaningful trials are easier to perform in specialised environments to advance the knowledge in the field. In vascular surgery, for instance, a complementary benefit of specialisation and centralisation has been clearly shown for the management of abdominal aortic aneurysms and carotid surgery.[9–11]

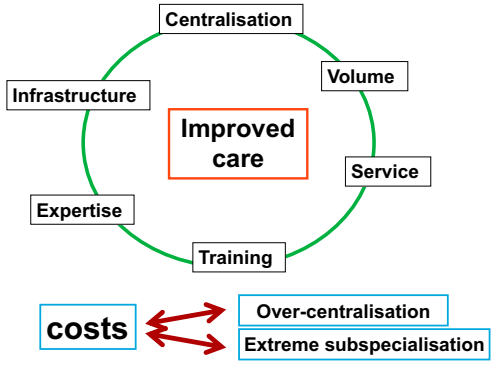

Figure 1 Advantages of centralisation: Specialisation has led, in many instances, to improved patient care, which is based on a self-sustaining circle of centralised services and may increase overall expertise. Over-centralisation and extreme sub-specialisation on the other hand are cost drivers.

On a personal level, specialisation is generally perceived to improve lifestyle and professional credentials and to increase job security since expertise usually comes along with reputation, independence and increased reimbursement.[3,12] Moreover, centralisation often facilitates sufficient staffing levels for 24-h on-call service with a reasonable burden for the individual.

Finally, trainees seem to be increasingly eager to achieve a good standing earlier in life and, thus, favour shorter training curricula. Expectations of an acceptable quality of life during training and concerns about patient safety have entailed political initiatives such as the European health and safety working time regulations. This evolution is likely to reduce the time available for surgical training in some European countries by approximately a third[13] and will independently drive surgical training towards early onset specialist fellowships.

Limitations of Specialisation

However, the positive relationship between increased specialisation and improved patient outcome certainly does not continue *ad infinitum*. Thus far, the zenith of this correlation (that is, at what degree of (sub)specialisation clinical outcomes improve the most) has not been defined as randomised evidence is lacking in this respect. It is clear, however, that increasing specialisation is associated with an orientation away from 'patient-centred care' towards 'disease- (or technology-) centred management'. This is known to generate additional costs driven by specialist training, added reimbursement and innovative technology, which is often associated with costly 'inventions' of new diseases.[12]

In addition, specialisation narrows working options for doctors to concentrated specialist services with associated inflexibility while over-centralisation signifies long distances and reduced availability of services for patients. Moreover, the focussing on technology-centred care creates ethical challenges as the typical 'technology hype cycle' leads to new techniques being adopted before safety and efficacy are established.[14] As most surgical innovations enter practice without regulatory oversight,[15] practice is running ahead of evidence. Thereby, patients are not only exposed to the learning curve of an emerging technology but also to an uncontrolled learning curve of any given surgeon, while the efficacy of the intervention might not even be certain. Thus, large centre volume alone may be only of limited benefit.[7]

Another limitation of over-specialisation is readily seen in non-elective care where it most easily leads to insufficient professional coverage. For instance, in a recent analysis of 1554 emergency patients, 23% needed a highly complex operation of which 30% did not even closely match the sub-specialty of the responsible consultant surgeon.[16] On a smaller scale, this probably applies for non-elective vascular surgery as well and has important implications on future training programmes.

Finally, although over the past decades, medicine has been dedicated in many countries to unlimited progress and technological innovation that comes with thriving specialisation, there is now general agreement that current annual

increases in health costs are economically disastrous and unsustainable. Drastic changes in overall values, patients' expectations and demands, industrial profit seeking and research aims will be inevitable to reduce these costs.[17]

Therefore, within this changing environment of surgical practice and education, the future surgical workforce is unlikely to encompass the same depth, breadth and availability of services that general surgeons historically provided.[18] As division of expertise progresses, the workforce of surgeons needed to provide standard service grows.[1] Hence, the gained quality of care for certain patients that is afforded by increased specialisation needs to be balanced against the limitations that it entails for other patients, the society and, last but not least, for the surgeon himself as extreme sub-specialisation is likely to produce a generation of bored and dissatisfied surgeons.[5] For vascular surgery, the emerging challenges are to determine the optimal level of specialisation *within* vascular surgery and to define its role and scope within *vascular care*.

Challenges within Vascular Care

Vascular care is being transformed profoundly not only because of the overwhelming expansion of knowledge and treatment options but also by emerging interests of competing specialties. The advent of endovascular technology has attracted interventional specialists from different directions while the increasing importance of best medical management[19] has led to specialised vascular physicians. All of these players contribute very different complementary skills — all of which are indispensable to integrated vascular care. None of them, however, seems sufficiently prepared to assume truly patient-centred care when isolated.

Given the competing interests and expertise, it can be difficult to determine who is best equipped to treat these extremely heterogeneous patients. For instance, patients with peripheral arterial occlusive disease suffer locally from a quite benign disease as only about 2.5% eventually face the risk of amputation.[20] *Quoad vitam*, however, their prognosis is as poor as for some malignancies.[20] Thus, is it truly the super-interventionalist, with his magic 0.014-inch hydrophilic guide wires, expensive adjuncts and almost exclusive concentration on tibial artery disease, who should be the therapy leader in this patient population? Without any doubt these endovascular wizards do incredible things to salvage limbs for individual patients. Using the same resources on screening, best medical treatment and careful patient selection within the same population, however, might have the potential to save many more lives instead of limbs.[21] Or, as another example, who is the appropriate specialist for my 76-year-old mother with her asymptomatic 75% stenosis of the left internal carotid artery? The absolute interventional carotid crack? Or the dedicated carotid endarterectomy surgeon with a major adverse event rate of less than 1%? Probably none of them, of course, but a patient-centred vascular care-provider who appreciates the risk balance between any intervention and the spontaneous risk of embolisation during her remaining life expectancy, and treats her with secondary preventive therapy.

Hence, although the vascular surgeon was traditionally the primary care-provider of the 'vascular patient', his role has become more controversial. To adhere to the self-conception of an unrivalled leader in all aspects of vascular care implies that the vascular surgeon also accepts a commitment to accumulate competitive knowledge, know-how and skills in all of treatment aspects (Fig. 2). This seems almost unfeasible in times of the European 50-h

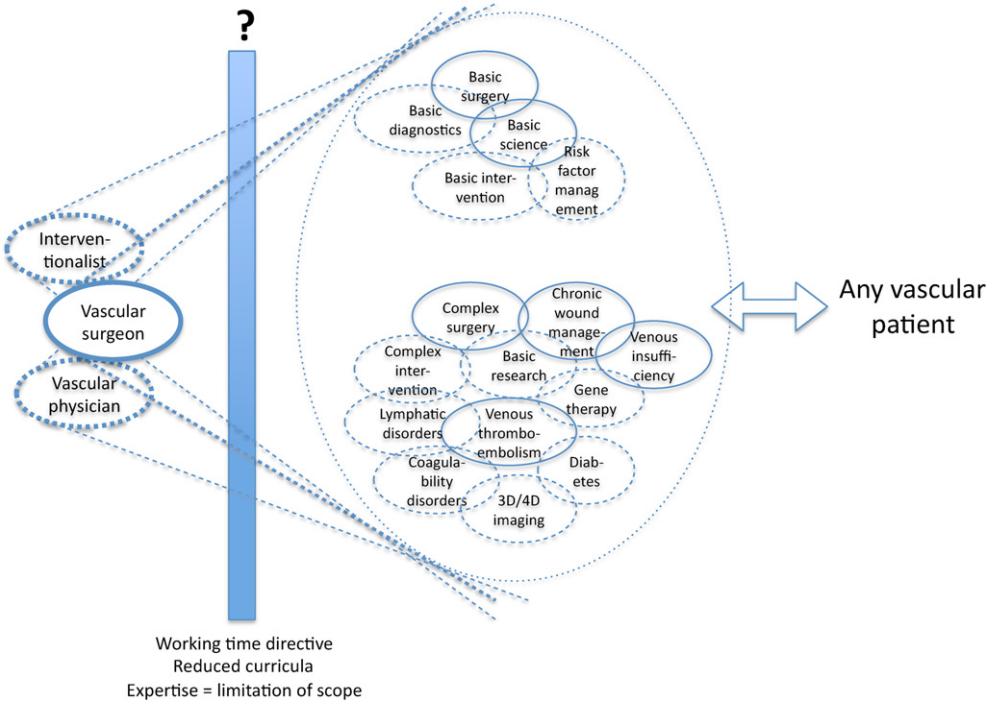

Figure 2 *'Encompassing vascular specialist'*-approach to vascular surgery training aims at a, likely unrealistic, *vascular generalist*.

work-week regulations, sprouting demands for shorter training curricula and the relatively young specialty (the *European Society of Vascular Surgery*, for instance, was only founded in May 1987) still remaining somewhat absorbed by its emancipation from general surgery.[2]

Implications for Vascular Surgery Training

In this era of re-allocation, a new paradigm of a 'vascular specialist' has emerged.[22] It advertises integrated training programmes for dedicated trainees to prepare them sufficiently and holistically for the expanding challenges of vascular care (Fig. 2) despite estimates that working time restrictions and increased vascular case load (+40% by 2020)[23] will reduce the time available for supervised surgical training dramatically. Thus, intensified programmes with earlier onset of specialist training are commonly being advocated.

By nature, training pattern follow the trends in current practice. In the US, for instance, complex open vascular surgery procedures have decreased enormously in favour of catheter-based procedures.[24] This was accompanied by a marked proportional shift of such procedures towards interventional cardiologists and vascular surgeons[25] and similar trends were observed in a recent European survey.[2] The impact of this trend on training pattern has been assessed by means of case log data from more than 100 participants of 86 training programmes: in 1999, the most commonly coded surgical procedure during a vascular surgery fellowship in the US was 'femoro-popliteal/tibial bypass or endarterectomy'; in 2008, however, it had changed to 'diagnostic arteriogram'.[24] A similar shift was found in another analysis.[26] Although sceptics of an 'all-encompassing vascular specialist' usually predict that considering increasing time restraints, future vascular surgeons need to focus on sub-specialty components to reach a safe level of surgical competence,[13] it is interesting that, in an analysis of endovascular procedures stratified by professional group, vascular surgeons had the lowest overall morbidity and mortality rates.[25]

Transatlantic Trends

In an idealised world, therefore, the modern vascular surgeon, in a limited amount of time, would accumulate adequate expertise: (1) in surgical core principles and techniques, (2) in non-invasive diagnostics of vascular disease and (3) in medical, endovascular and open surgical treatment.[27] Accordingly, adapted training programmes were proclaimed as early as 2006 by the American Board of Medical Specialties (ABS) and the Accreditation Council for Graduate Medical Education (ACGME).[28,29]

Trainees can enter such ambitious programmes directly after graduation and pass through a series of well-defined educational steps. The first 2 years are dedicated to core surgical education, including pre- and postoperative evaluation and care, critical care and trauma management, basic technical surgical training in skin and soft-tissue handling, abdomen and alimentary track surgery, airway management, laparoscopic surgery and thoracic surgery. The remaining 3 years are dedicated to concentrated vascular surgery including a catalogue of 500 operations (200 major vascular reconstruction procedures) and 1 year of chief resident responsibility. In addition, trainees are expected to reach mastery in endovascular skills and best medical management. In a similar fashion, most European countries have concentrated their vascular surgery training curricula from around 9 years (including 6 years general surgery training and 2–4 years vascular surgery training) to around 6.5 years (including 4–5 years general surgery training and 2 years of vascular surgery training, respectively) and adapted their content.[2] Unsurprisingly, specialist training tends to be more intensive in countries where vascular surgery is an independent specialty.[2]

Have these re-organised curricula actually paved the road towards the perfect 'vascular specialist' (Fig. 2)? Doubts will certainly arise in the mind of any surgeon who remembers the 'efficiency' of the first few years of his own surgical training and the number of procedures needed to achieve true mastery in tissue handling and in anticipation of problems. The question of how much core training in general surgery is necessary is important considering how much more effective specialist training usually becomes with a certain degree of surgical expertise. Similarly, how much of important 'vascular experience' can be left for the general surgery trainee? As stated above, the increasing lack of vascular exposure already imposes severe problems for the provision of a safe general emergency service.[16,30]

However, the truly disturbing aspect may be that such an interpretation of the 'vascular specialist' seems evocative of a vascular 'generalist' rather than a true 'specialist' and, thus, what seems to occur in vascular surgery is a trend towards de-specialisation, rather than sub-specialisation! Yet, the skills that are needed for a carotid artery angioplasty/stenting with completion angiography as compared with a re-do operation of an infected aortic graft are probably as diametrically opposite as flying a small Cessna airplane or a jumbo jet. Interestingly, the 'vascular specialist' has primarily been advocated by vascular surgeons, thus far,[31] in an attempt to keep endovascular know-how. It should be noted, however, that without dedicated endovascular or internal medicine training, it is as illusory to obtain a competitive degree of expertise in the respective fields as it would be for interventional radiologists or vascular physicians to become vascular surgeons with a 'light' training programme.

Potential Future Directions

Although all emerging training programmes essentially aim at similar goals, their structure is astonishingly heterogeneous,[2] indicating that the ideal modalities have yet to be defined. A common feature seems to be the integration of virtual-reality simulators, at least for endovascular training. Although the value of simulation for bridging the gap between reduced training time and clinical reality is no longer debated, corresponding training scenarios for open surgical procedures are much less established. At least, their potential is increasingly recognised as could be heard at the 2009 Society of Vascular Surgery meeting in

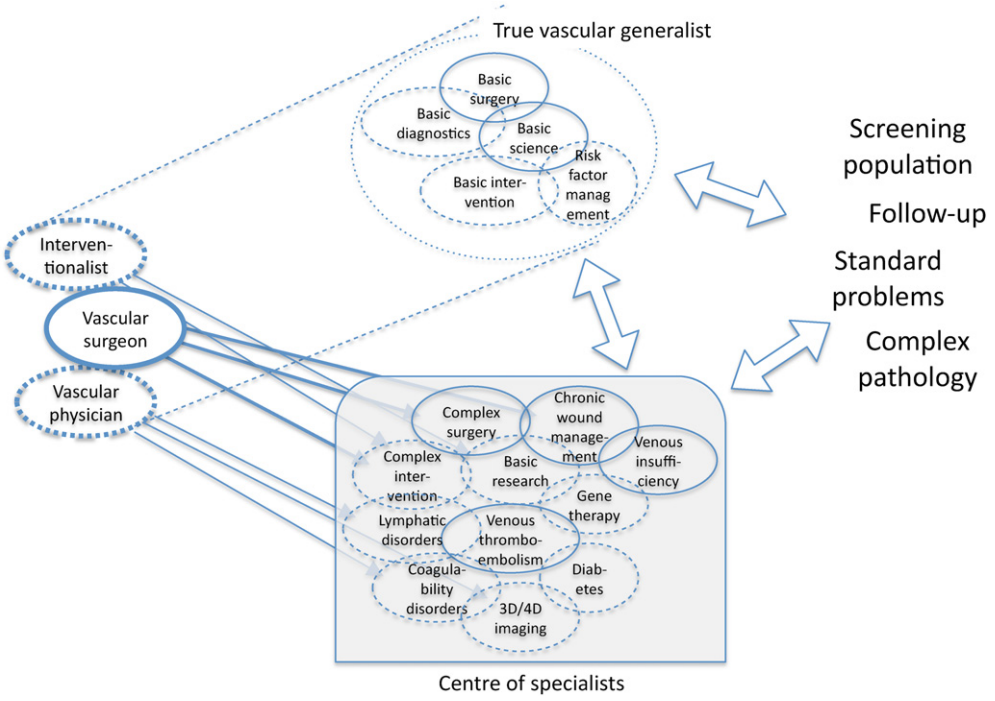

Figure 3 '*Vascular centre*'-approach: the 'common language' of general vascular disease management creates the base for true vascular generalists as first line carer and for unbiased management of complex disease within a vascular centre.

Denver, USA. Of course, such surrogate scenarios cannot entirely substitute for clinical experience; however, their integration into official vascular surgery curricula might meet at least some of the current challenges. Accordingly, open vascular surgery workshops are being offered and propagated more and more (http://www.vascular-international.org).

Certainly, multiple flexible training paradigms will continue to co-exist as vascular surgery evolves;[32] however, some generally accepted principles seem to emerge including an increasing shift towards open and endovascular virtual-reality simulation and the belief that surgeons have to focus on dedicated training time and should reach competent specialisation through certified completion of defined curricula rather than by simply attending to a fixed duration of training.

The reasonable degree of sub-specialisation likely depends primarily on the individual working environment.

As the typical vascular patient is elderly and polymorbid, he should preferably enter 'one door' to find unbiased access to all vascular care under one roof — the 'vascular centre.'[33] First propagated in the late 1980s, this concept is still unique in its promise to overcome the limitations of individualised specialisation. Only interdisciplinary work-up including conjoint evaluation by vascular physicians, vascular surgeons, interventionalists and cardiologists, and including conjoint development of a comprehensive treatment plan offers both, 'breadth' of encompassing patient care and 'depth' of sub-specialisation expertise (Fig. 3). Prerequisites, however, are a mutual basic expertise to facilitate discussions on common grounds and upfront negotiations of reimbursement distributions.

Hence, the vascular surgeon of the future should realistically: (1) have profound expertise in one field, be it endovascular or open surgical (Fig. 4); (2) have an in-depth knowledge of the available evidence; (3) be an integral part

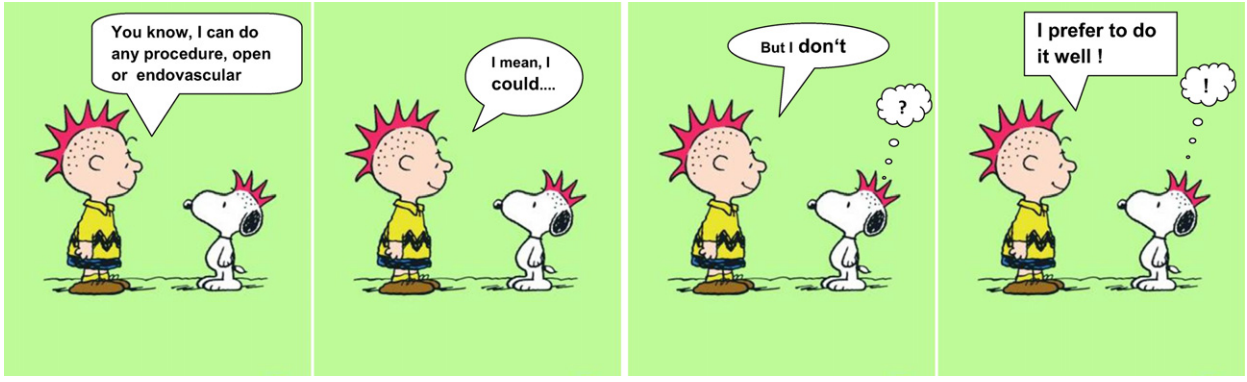

Figure 4 Relative specialism.

of a multidisciplinary team that offers the whole therapeutic spectrum; and (4) have a thorough understanding of vascular biology. Thus, a specialised interest should be developed in close interaction with specialist partners. Vascular surgery training programmes need to provide such 'relative specialists' and should probably consider collaborative efforts with other vascular specialist training programmes to reach this ambitious goal.[34] However, as a 'core knowledge' is paramount, any vascular training must encompass general aspects of vascular care regardless of the provenance of its specialty, just as any surgical training programme must continue to train core surgical skills.

Conclusion

We should accept that vascular surgery, despite its short existence, has already outgrown the scope of a monospecialty. Thus, sub-specialisation is required to benefit from 'disease-centred expertise'. Most vascular patients, however, probably need less of a purely technical specialist than a dedicated and sympathetic care-provider with balanced appraisal of overall risks and a (cost-) effective management (i.e., 'patient-centred care'), particularly in times of limited resources. In any case, subspecialisation requires interdisciplinarity and vascular training needs to foster skills accordingly. With restricted training time, virtual-reality simulation will become increasingly important for endovascular and open surgical training and will help reducing the negative impact of technical learning curves. In conclusion, we advocate a relative specialism, which is integrated in a close and transparent network of partners with enough common base for consensual decision making ('vascular centre'). The exact modalities of corresponding training programmes have yet to be defined and likely depend primarily on local circumstances.

Conflict of Interest/Funding

None

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